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Design & Development of Efficient Routing Protocols in Mobile Ad-Hoc Networks

Short Synopsis

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ABSTRACT

Wired Networks or Cellular Networks are unsuccessful in compromised physical areas/ environments such as battle fields, submarines, underground bunkers, flood, earthquake & fire. Wireless Networks is a thirsty area of research due to its easier deployment and worldwide usefulness. As per the current scenario or necessity worldwide, self-organizing and efficient wireless systems are required with quick adaptability to mobility, quick & trouble-free deployment and reduced costs. Mobile Ad-Hoc Networks (MANETs) are user-friendly, self-governing dynamic systems of movable devices, allowing users to access a broad range of information, data and services, when they are mobile, irrespective of their geographical bias. MANETs offer several benefits like- low prices & enhanced flexibility and better speed of data transmission and have mesmerized momentous significance in recent years with fast continuous growth.

Designing an efficient routing protocol incorporating all characteristics of an ideal protocol has been a burning research area in MANET. Yet, significant research has been done to enhance the performance of routing protocols. To overcome the limitations of proactive routing protocols, a Novel approach will be proposed for an efficient MPR selection based on proactive routing protocol, aimed at reducing the memory overheads and higher control overheads associated with the proactive protocols, leading to the increased network longevity, more stable and reliable paths. The proposed algorithm will be compared experimentally with existing protocols and also, an effectual performance evaluation will be done. Further, an optimization approach will be applied to enhance the performance of the proposed approach.

Key words: MANET, Routing Protocol, DSDV, OLSR, MPR Selection

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1. Introduction

1.1 Wireless Networks- Necessity

Devices which are capable of transmitting and receiving signals, through guided or unguided media are essential elements for establishing communication in a network, with the intention of distributing information, data or resources. Wired networks send data from one host to another through guided media (such as twisted- pair, co-axial or fiber optic cables). On the other hand, wireless networks transmit data from one device to another through unguided media (such as waves from Electromagnetic spectrum). Wired networks are entirely dependent on the physical infrastructure and hence limit facilities and freedom from movement. Moreover, Wired Networks are not successful in Compromised Physical Areas/ Environments such as battle fields, submarines, underground bunkers, flood, earthquake & fire.

Wireless Networks is a burning area of research due to its worldwide usefulness and easier deployment. Based upon necessity of an infrastructure, Ad-hoc networks and cellular networks are the two categories of wireless networks. The cellular networks such as GSM/ CDMA/ LTE facilitate freedom of movement but, being an infrastructure based networks, limits the adaptability of wireless systems in compromised practical scenarios such as battle fields, submarines, underground bunkers, and emergency search & rescue operations such as fire, flood and earthquake.

As per the current necessity worldwide, self-organizing and efficient wireless systems are required with quick & trouble-free deployment, reduced costs and quick adaptability to mobility. Bluetooth technology introduced wireless infrastructure independent network, called as Ad-hoc network, but it provides ad-hoc capability limiting to only peer-to-peer node, without multi-hop radio relaying and network spans only up to few meters without satisfying all the requirements and characteristics of Mobile Ad-Hoc networks (MANETs). Likewise, variant wireless technologies such as Zigbee, Zwave etc. are also unable to meet all the desired features of MANETs. The meaning of Mobile is “moving” and meaning of ad-hoc is “for this purpose only or temporary”. MANETs can be defined as self-governing dynamic networks of intelligible movable devices, characterized by multi-hop provisional wireless links, frequent link breaks and easy establishment.

1.2 Comparison between Mobile Ad-Hoc Networks and Cellular Networks

This section presents the comparison between Ad-hoc wireless networks and cellular networks as shown in Table 1.

Table 1: Comparison of Mobile Ad-Hoc & Cellular wireless Networks

Cellular Networks	**Mobile Ad-Hoc Wireless Networks**
Dependent on Infrastructure.	Independent of Infrastructure.
Bandwidth is guaranteed.	Radio channel is shared.
Routing is done in a centralized manner.	Routing is done in a decentralized manner.
Data Switching Technique: Circuit-switching.	Data Switching Technique: Packet-switching.
Comparatively continuous connectivity.	Link breaks frequently.
Deployment is time consuming & costlier.	Easier & faster, cost effective Deployment.
Easy bandwidth reservation.	Complex MAC protocols are required for bandwidth reservation.
Applicable for commercial and civilian sectors.	Applicable in compromised practical scenarios such as battle fields, submarines, underground bunkers etc.
Network maintenance is expensive.	Built-in maintenance and Self-configuration.
Relatively simple mobile nodes are required.	Intelligible mobile nodes are required, with routing capability.
Desired routing objective is to increase the frequency of call acceptance and minimizing the call drop.	Desired objective of routing is goal efficient route establishment and also rapid recovery from broken links.
Globally deployed and at the present, in the fourth generation of evolution.	Successful commercial deployment requires several existing issues to be resolved.

1.2 Broad Categories of Routing Protocols in MANET

In order to determine paths between mobile devices, routing protocol is required, which can result into quick reconfiguration from broken links. In the absence of centralized assistance, all the nodes coordinate to enable distributed routing and resource management. Based upon working mechanism, the routing protocols for MANETs may be grouped under Table-driven, Reactive and Hybrid categories. The protocols which maintain routes prior to data transmission are known as proactive protocols, whereas reactive category discovers routes only on demand basis.

Designing an efficient routing algorithm incorporating all constraints pertaining to ad-hoc networks, with optimal bandwidth consumption is still a hot area for research due to several unresolved issues. Design issues of routing protocols include- mobility, limited Radio Band, varying link capacity, error-prone wireless link, collision of packets due to hidden terminal problem, limited battery life, and processing power. In the race of multiple routing protocols, some measures are required to analyze efficacy of protocols in various scenarios. Performance Parameters of Routing Protocols include- Throughput, Packet Delivery Fraction (PDF), Average End-to-End Delay (EED), Routing Overheads (RO), Normalized Routing Load (NRL), and Packets Loss (PL). The differences between proactive and reactive protocols are shown in Table 2.

1.3 Application Areas of MANET

Mobile ad-hoc networks can be deployed anywhere easily, despite of the place and time, as they are not constrained by the infrastructure setup. Therefore, there are widespread applications of MANETs due to its useful characteristics and easy deployment.

- **Military Applications**: MANET is useful in establishing the communication in a battle field, as it can be easily established in the absence of an infrastructure. It supports built-in geographical location, soldiers can triangulate their position based on the mobile enabled vehicles or other devices. They can use instant messaging to send pictures of the enemy positions back to the control command & use VoIP to communicate with the non-military personnel's in an occupied area.
- **Disaster areas:** In large scale disasters such as earthquake, volcanic eruption or landslides, the infrastructure-based wireless network is not successful as the base station

and other elements comprising the infrastructure may be damaged. MANET is recommended in disaster areas as it offers quick & cost-effective deployment, infrastructure less nature, autonomous light weight mobile terminal and dynamic topology.

- **Collaborative/ Distributed Computing:** A group of people can easily form a temporary communication infrastructure using an ad-hoc network & share data, with their mobile devices, where no network service is present.

- **Emergency Operations**: Freedom & flexibility of mobility, self configuration, independence from fixed infrastructure and easy deployment favor MANETs for, crowd control, emergency search & rescue and commando operations.

- **Wireless Mesh Networks (WMN)**: It is a category of wireless ad-hoc network. It provides many alternate paths between a source and destination. Mesh routers may be mobile or fixed and strong enough with respect to resources.

- **Wireless Sensor Networks (WSN)**: This is another category of ad-hoc networks. It use sensors employed in a particular application area, to enable communication among distributed autonomous devices. Sensors have the ability of sensing environmental or physical variables. Some of the civilian application areas of WSN are: healthcare applications, environment and habitat monitoring, traffic control & home automation.

- **Hybrid Wireless Network**: Integration of cellular & ad-hoc networks characteristics gave birth to hybrid wireless networks. It inherits the benefits of both types of networks.

Table 2: Comparison between Proactive and Reactive Protocols

Proactive Protocols	**Reactive Protocols**
Inherits features from traditional distance-vector and link-state protocols.	Source builds routes on demand by "flooding".
Maintains routes prior to data transmission or need.	Maintain only active routes.
Routes are available prior to need.	Route Discovery cycle, for finding routes as per the need.
Periodic and/or event triggered route-updates.	Routing updates as per the requirement.
Higher overheads in most scenarios because of continuous updates.	Typically, less control overheads, better scaling properties.
Low latency of packet forwarding, as the route is available prior to transmission.	Route acquisition latency or long delay in finding the route.
Large routing tables.	Small or No routing tables.
Examples Include: DSDV, WRP, OLSR, CGSR etc.	Examples Include: DSR, AODV, TORA, LAR etc.

2. Literature Review

This section presents the current trends and work carried out, intended to improve the performance of proactive routing protocols, along with relative analysis of various routing protocols.

E. Mahdipour et al. (2009) assessed the working efficiency of a DSDV protocol in MANET. They have used NS-2 simulator for performing simulations with CBR traffic pattern and varied pause times. They have calculated the end-to-end delay and dropped packet rate. Authors have drawn conclusion based on their simulation results that, the packet loss & end-to-end delay increases as the no. of connections and the node speed increases.

Khan et al. (2008) have proposed the Eff-DSDV protocol. They have presented a broken route repair scheme, in order to get rid of stale routes and consequently to improve the performance outcomes of a DSDV routing protocol. They have used NCTUns simulator for implementing the Eff-DSDV protocol and analyzed its relative performance with a DSDV protocol. They have considered different performance parameters like, routing overheads, end-to-end delay, packet delivery fraction, packet loss, and route length. As per the experimental results, Authors have drawn conclusion that, the Eff-DSDV outperforms a DSDV protocol, when no. of nodes & node speed is varied. But, the Control Overhead is slightly higher for the Eff-DSDV protocol than DSDV protocol.

Ting Liu and Kai Liu (2007) have presented an invalid route reconstruction scheme in DSDV protocol. Their protocol also repairs broken links resulting in an improved DSDV protocol in respect of the packet delivery fraction. Based on experimental results, they have observed that their proposed protocol named I-DSDV, is quickly adaptable to frequent topology changes and reduces data packet loss thereby increasing little overheads in highly mobile scenarios.

Jia Lu et al. (2012) have also proposed modifications to the original DSDV protocol, with respect to Invalid route reconstruction problem. Their proposed protocol does not need any

additional message exchange for route repair but, each node is required to maintain two routing tables. As per their simulation results, packet delivery fraction is improved.

P. Jacquet et al. (2001) developed an OLSR routing protocol, destined to employ in MANETs. It's an improvement over a traditional link state protocol. It employs the technique, known as multi-point relaying. Instead all, some neighbors are selected called Multi-Point Relays (MPRs) for efficiently and economically flooding the control information. Authors claimed that, their proposed protocol should best suit to denser & large Ad-Hoc Networks

Deepali Arora et al. (2011) as per the simulation results, claimed that the OLSR does not attain the desired performance goals in larger & dense multi-hop mobile networks and it performs well only when maximum nodes are nearly still. But, their simulation outcomes contradict some other claims (P. Jacquet et al. 2001, Rahman M. and Muktadir A. 2007 and S. Mohapatra and P. Kanungo 2012) that the OLSR is specifically appropriate for larger & denser ad-hoc networks.

S. Mohapatra and P. Kanungo (2011) based on their simulation outcomes, observed that the OLSR is a superior option as compared to other proactive protocols, for highly dynamic networks, if the size of a network is greater than 600m × 600m and if, the application-oriented metrics viz. PDF and Throughput are the key criteria.

S. Mohapatra and P. Kanungo (2012) in their subsequent publication performed a comparative assessment of AODV, DSR, OLSR & DSDV routing protocol using NS-2 simulator. They have analyzed- packet delivery ratio, throughput, and routing overhead and concluded that the OLSR gives better packet delivery fraction relatively.

Zheng Yihui et al. (2010) have suggested improvements in OLSR protocol and named their protocol as- N3S-OLSR. To calculate Multi Point Relay sets, it also utilizes self- sensing information & hop count, unlike OLSR protocol. The Node Status Information and Link Status Information are maintained by every node. Their proposed algorithm reduced the probability of choosing weaker nodes with poor processing capacity & poor link properties as an MPR node. Authors observed that as compared to OLSR protocol, the N3S- OLSR improved the packet delivery ratio and prolonged the average path duration.

Shakeera (2010) has modified the MPR selection criteria in OLSR, to select MPRs optimally and named modified algorithm as-"Necessity First Algorithm (NFA)". As per Author's observation, traditional MPR selection algorithm does not select optimal MPRs with respect to performance parameters. Simulation demonstrates that the modified algorithm- NFA has improved PDF & throughput as compared to greedy algorithm.

Wang Anbao and Bin Z. (2014) aimed at reducing the blindness in a Multipoint relay selection algorithm of the OLSR protocol, Authors have suggested modified MPR selection criteria, based on node localization information. Their modified algorithm has reduced the routing overheads in the network to a certain extent.

Yamada Kenji et al. (2010) have made efforts for reducing the control overheads of the OLSR routing protocol. Authors have observed that, in original OLSR protocol, the MPR selection algorithm executes on every node independent of its neighbors and therefore, exhibits redundancy. They have also observed that in a dense network, redundant control messages can be included into a single control packet. Based on the simulation results, their proposed modification in MPR selection algorithm reduced the no. of Topology Control (TC) messages in OLSR protocol in denser networks.

Yamada Kenji and Tsuyoshi Itokawa (2010) have presented a non-distributed cooperative MPR selection algorithm in their subsequent publication, aimed at reducing the no. of topology control messages in the OLSR protocol. However, due to its centralized approach, it's incompatible to be implemented in OLSR.

Teruaki Kitasuka and Shigeaki Tagashira (2011) have worked in the direction of reducing the redundancy in terms of total no. MPRs selected. They have also proposed an MPR selection algorithm but, with centralized approach. They have measured the MPR ratio and Routing Overheads contributed by the TC messages.

Leonardo Maccari and Renato Lo Cigno (2012) have worked to reduce the total no. of MPRs in the network and therefore, the control overheads. As sper their proposed strategy, while selecting MPR nodes, higher priority is given to those nodes that have already been

chosen by some other nodes. Based on simulation outcomes, their proposed algorithm performed better and achieved up to 15% reduction in control messages.

Teruaki Kitasuka and Shigeaki Tagashira (2013) have worked in the interest of reducing the TC traffic of OLSR protocol, in their subsequent publication and proposed a method for MPR set selection on sharing basis. Every node calculates the degree of coverage for each of its MPR node. This additional parameter "degree of coverage" is appended with Hello message, in order to determine if the MPR set of a corresponding node could be overlapped with Multipoint Relay sets of the neighbor nodes.

Teruaki Kitasuka and Shigeaki Tagashira (2015) in continuation of their work, proposed a non-distributed algorithmic to share MPRs with neighbors in order to reduce Routing Overheads. Their algorithm runs globally on the entire network rather than on each node and reduced the MPR ratio. But, centralized algorithm is not directly applicable to OLSR or other MANET routing algorithms.

3. Description of Broad Area

3.1 Mobile Ad-Hoc Networks

Mobile Ad-Hoc Networks are user-friendly, self-governing dynamic systems of movable devices, allowing users to access a broad range of information, data and services irrespective of their geographical bias, when they are mobile. MANETs offer several benefits like- better speed of data transmission, low prices & enhanced flexibility and have mesmerized momentous significance in recent years with fast continuous growth. Being a part of an autonomous network, each node needs to be an intelligent participant for transmitting & receiving data as well as for relaying data received from other nodes, acting as a Router.

MANET is an instantaneous collection of dynamic nodes linked with provisional wireless links as shown in Figure 1. Each host has limited range for wireless transmission. Node communicates with the host outside its transmission range, by forwarding packet to the nearby host to the destination. Dynamic topology due to provisional wireless links imposes challenges in developing an efficient routing protocol. Limited resources and high mobility make the routing mechanism a difficult chore.

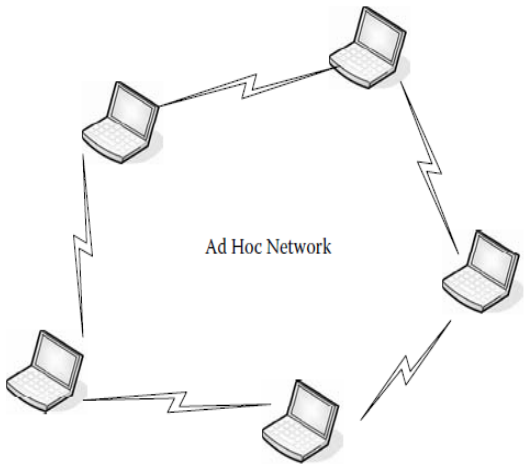

Figure 1: Infrastructure-less Network

3.2 Proactive Routing Protocols

Based on the working Principle, routing protocols can be categorized as- Proactive, Reactive and Hybrid protocols. As per the Proactive or Table-driven routing algorithms, every node constantly keeps record of routing information of the whole topology in one or more routing tables. These protocols are called proactive in nature, as each node store and maintain route to all destinations prior to any data transmission. The Figure 2 depicts a network scenario of nine nodes positioned arbitrarily. The Table 3, represents the routing table of a Node- 'S', it keeps record of routes to every other node in the network. These protocols intend to maintain a consistent an up-to-date network view by propagating routing information updates all around the network. Despite mobility, in these protocols, communication delay is lower as path is already available in the routing table of each node, prior to data transmission. But, in a desire to retain fresh routing information, these protocols suffer from higher control overheads. Examples of table-driven routing algorithms include: Destination-Sequenced Distance-Vector (DSDV) Protocol, Optimized Link State Routing (OLSR) Protocol, Wireless Routing Protocol (WRP) and Cluster-Head Gateway Switch Routing (CGSR) Protocol. Design issues of routing protocols [28] include- Mobility, Bandwidth Constraint, Error-Prone Shared Broadcast Radio Channel, Hidden & Exposed Terminal Problem, Resource Constraints and Characteristics of an ideal Routing Protocol.

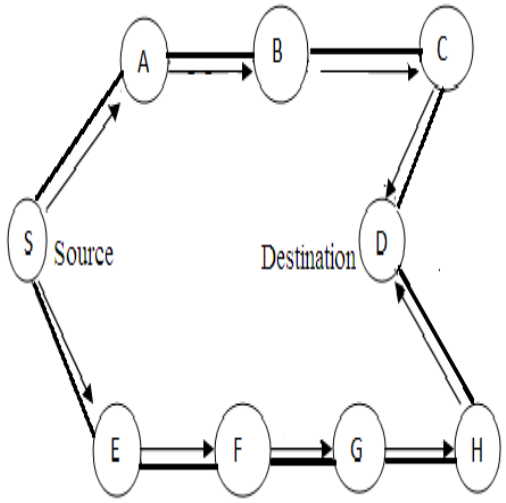

Figure 2: An Ad-Hoc Network Scenario

Table 3: Routing Table of a Node-'S'as per the DSDV Protocol

Destination	Next-Hop	Hop-Count
A	A	1
B	A	2
C	A	3
D	A	4
E	E	1
F	E	2
G	E	3
H	E	4

3.3 Open Issues & Challenges in MANET

Besides Widespread applications, MANET's commercial deployment suffers from several issues. In mobile networks there are several challenges to work upon: frequent path breaks due to random motion of devices and absence of central administration, make routing a challenging task as compared to wired networks. Wireless link capability frequently vary, In contrast to wired networks, due to transmission impediments such as path loss, fluctuations in signal strength, noise and interference. The key issues that need to be addressed and resolved for efficient design & deployment of MANET are as follows:

- Bandwidth limitation
- Asymmetric links
- Scalability
- Different link capacities
- Energy constraints
- Efficient & Secure Routing Strategies
- Multi-hop routing
- Routing overheads
- Multicast Routing
- Reliableness
- Security at Data Link Layer
- Limited network security
- Non uniformity of devices
- Service Quality

4. Problem Identification and Objectives of the Study

The section 4.1 presents the various open issues in designing, development and enhancing the performance of proactive routing protocols. The section 4.2 presents the gaps in literature, followed by problem definition in section 4.3 and objectives of the study are presented in section 4.4.

4.1 Open Issues in Proactive Protocols

- Higher Control Overheads in Proactive Protocols
  - Proactive routing protocols exhibits higher control overheads, as they intend to maintain the consistent topology information, irrespective of data transmission needs.
  - Rigorous Analysis shows that, OLSR protocol has higher Control Overheads relatively to other proactive protocols such as DSDV.

- Higher Energy Consumption in Proactive Protocols
  - Being compelled by nature, proactive protocols constantly consume energy in computing and maintaining all routes, prior to data transmission.

- Poor Network Longevity/ Lifetime or Frequent Route Failure.
  - Nodes mobility in MANET is one of the reasons for link breaks and network instability. Also, limited battery power is another constraint to be considered for network longevity.

4.2 Gaps in Literature

- Mobility of nodes and resource constraints, have made routing a complex task in MANET. Very few researchers have worked in the direction of analyzing the process of Routing Table construction in the OLSR protocol and given due consideration to memory overheads associated with the OLSR protocol.

- Also, as per the available literature, very few Researchers have worked in the direction of selection of optimized shared Multipoint Relay sets in routing protocols, which could result into better network longevity.

- Moreover, other Authors (Yamada Kenji et al. in 2010, Yamada Kenji and Tsuyoshi Itokawa in 2010, Teruaki Kitasuka and Shigeaki Tagashira in 2011 and in continuation of their work in 2015) have presented a non-distributed approach to share MPR nodes with neighbor nodes but, their centralized approach is inappropriate to be implemented in the MANET routing protocols.

4.3 Problem Statement

To design a Novel approach for efficient shared MPR selection based on proactive routing protocol in MANET. In a denser network, for any node 'x', there can be more than one MPR set. Each node providing reachability to same number of 2-Hop neighbors may be there as an MPR node in different independent MPR sets. It's nondeterministic in original MPR selection heuristic that, which node is to be selected as an MPR node, when two equally potential participants are available. Also, it does not take into consideration, the existence of multiple MPR sets in a denser network and hence, do not provide any criteria for selecting an MPR set amongst multiple MPR sets, which can result into reduced routing overheads and better network longevity.

4.4 Objectives of the Study

The general aim of this research work is to explore & examine the working mechanism & performance of various Routing Protocols in MANET and to enhance their performance effectively. Key Aim of routing is to explore routes with minimum overheads. One of the prior requirements for saving the resources in the network is reducing overheads. So, the Focused objectives include:

- To perform rigorous relative exploration of DSDV and OLSR routing protocols in MANET and focus on limitations.
- To enhance the performance of routing protocols in MANET, aimed at improving the network lifetime, routing overheads, packet delivery fraction and packet loss.
- To develop efficient routing protocols based on proactive approach.
- To reduce the memory overheads in OLSR routing algorithm.
- To minimize the control overheads in proactive routing protocols.
- To reduce energy consumption in proactive routing protocols.
- To execute the proposed routing strategy on standard simulation tool and analyze the impact on various performance metrics.

- To compare the proposed routing approach with existing routing protocols on standard simulation tool and validate the outcomes through augmentation of QoS parameters viz., increased packet delivery fraction, reduced packet loss and routing overheads, improved network life time and limited bandwidth usage.
- To incorporate a meta-heuristic technique to further optimize the results.

5. Methodology to be adopted

5.1 Analytical Study

- Study and Analysis of various Issues & Challenges in MANET.
- Literature Survey to Understand the Working principle of various Routing Protocols in MANET.
- Understanding Various Design Issues & Performance Measures of Routing Protocols.
- Analytical Analysis of DSDV Routing Protocol.
- Analytical Analysis of OLSR Routing Protocol.
- Designing a New Routing Protocol based on Proactive Routing Approach.
- Comparative Analytical Exploration of the Proposed Routing Strategy with the Existing Routing Protocols.
- Understanding & Gaining Comprehensive Knowledge relating to Usage of a Network Simulator-2.35 tool.

5.2 Simulation Study

- Experimental Exploration of a DSDV Routing Protocol on Network Simulator-2.35.
- Simulation Exploration of an OLSR Routing Protocol on Network Simulator-2.35.
- Comparative Simulation Analysis of the OLSR & DSDV Routing Protocols and Evaluation of simulation results.
- Simulation Analysis of the Proposed Protocol, verification based on Literature Survey, Drawing Conclusion with Recommendations and Specifying Future Scope.

5.2.1 Simulation Tool

Many simulators are available such as OPNET, NetSim, GloMoSim, QualNet and NS-2, which are used for network simulations in MANET. We have considered the discrete event simulator- NS- 2 for simulation, analysis and evaluating parameters. It is a freeware, which has been widely used in the literature and has been very effective in quite diverse situations.

The NS- 2.35 installation includes some built-in routing protocols like DSDV, TORA, AODV & DSR, but OLSR is unavailable with it. To analyze the performance of a routing protocol, different metrics are used namely, Throughput, Packet Delivery Fraction, Routing

Overhead, End-to-End Delay, Normalized Routing Load and Packet Loss. We need to enumerate and set the network parameters required for performing simulations on NS-2. The simulator is configured with necessary parameters viz., the name of the protocol, no. of nodes, type of traffic pattern, type of mobility model, duration of simulation etc. The basic methodology of the simulation process is shown in Figure 3. It accepts scenario file as an input, which presents the movement pattern of every node. After each simulation run, trace files are generated as an output, which are stored on disk. Script written in awk is used to extract results and analyze trace files.

The following parameters are specified to analyze any Ad-Hoc network on NS2:

- **Terrain Size:** Physical area of the network where nodes can move.
- **Size of Network:** Total number of nodes in the network.
- **Routing Protocol:** Protocol used such as DSDV, AODV, DSR etc.
- **Traffic Pattern:** TCP, CBR, UDP, etc.
- **Network Load:** The number routing packets and data packets being handled during the simulation.
- **Mobility:** Pattern of node movement such as random or directional or in specified order.
- **Speed of Node:** Average speed of the nodes or the speed of an individual node.
- **Simulation Time:** The duration for which the simulation runs.

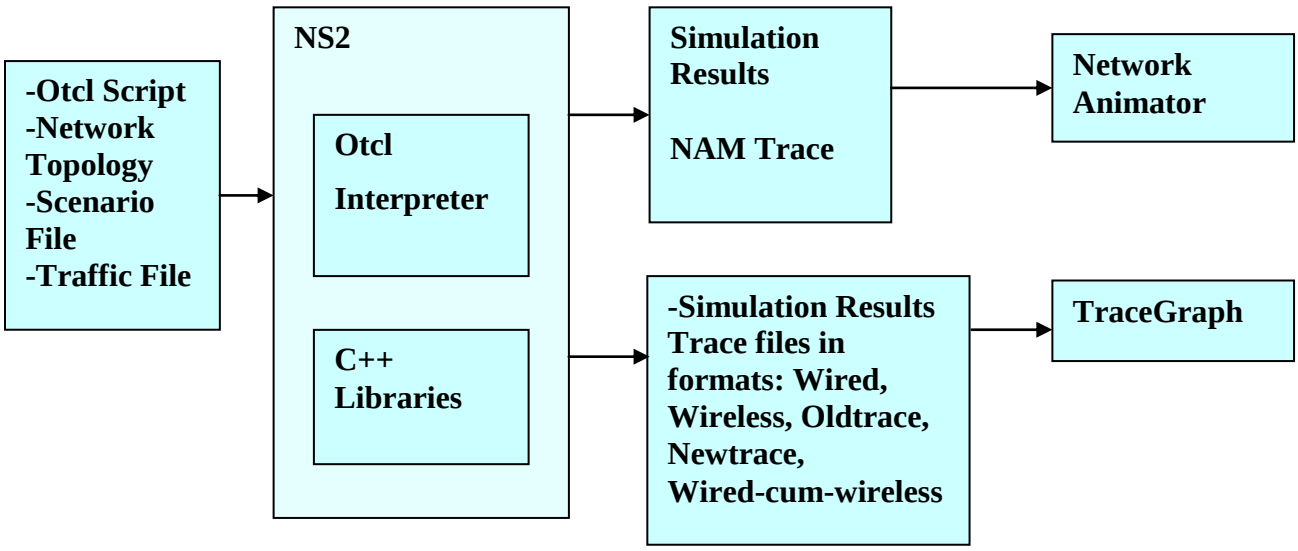

Figure 3: Simulation Stages in NS2

6. Expected Outcomes of the Research Work

- Understanding of working Principle of various Routing Protocols in MANET.
- In-depth Understanding of Working of DSDV Routing Protocol.
- In-depth Understanding of Working of OLSR Routing Protocol.
- Understanding of differences in Internal Architecture & Working Mechanism of OLSR & DSDV Routing Protocols.
- Understanding of simulation process & steps for performing simulations on NS-2.
- Understanding of Pros & Cons of OLSR & DSDV Protocols, based on simulation results.
- Development of an Efficient Routing Protocol based on Proactive approach.
- Congestion Control in the network due to unnecessary routing updates, with the proposed Protocol.
- Proposed Protocol is Expected to Improve:

- The Network Efficiency in terms of Increased Packet Delivery Fraction and Reduced Packet Loss.
- Routing Overheads and limiting Bandwidth usage, which is a scarce resource.
- Overall Network Lifetime with more Stable & Reliable paths.

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